

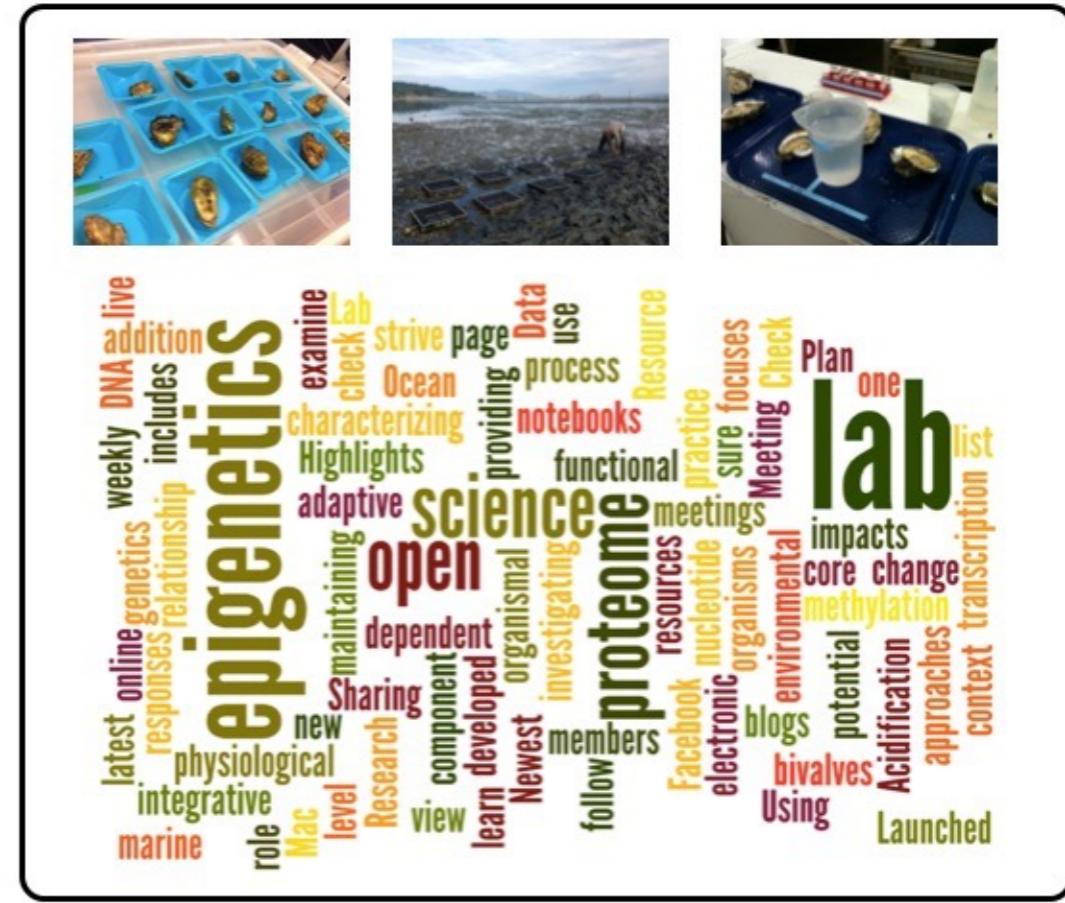
# Towards a functional understanding of DNA methylation in shellfish and implications for aquaculture

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**[robertslab.info](http://robertslab.info)**

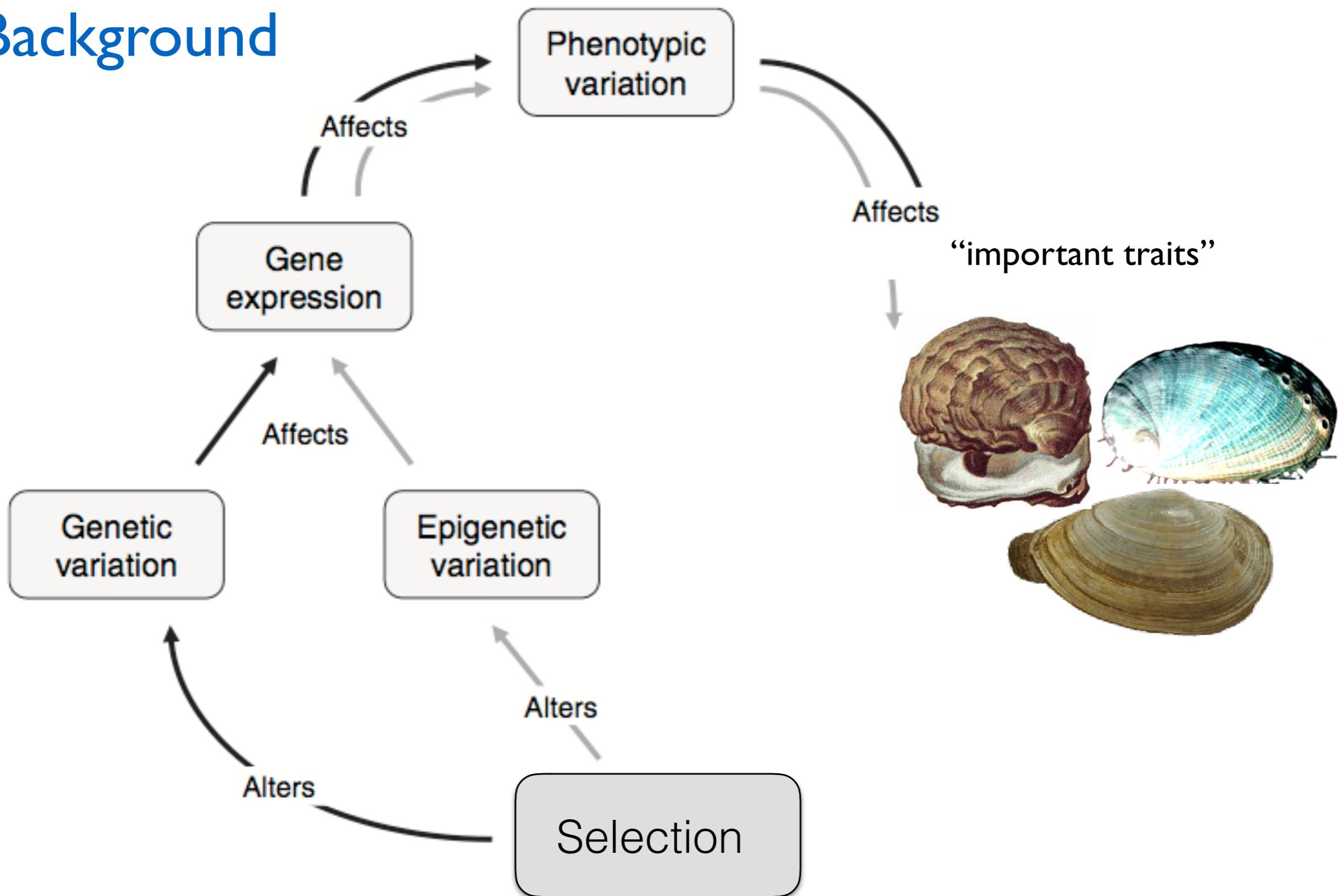
@sr320

# **44<sup>th</sup> Scientific Symposium of the UJNR Aquaculture Panel Genetics and Breeding in Aquaculture**

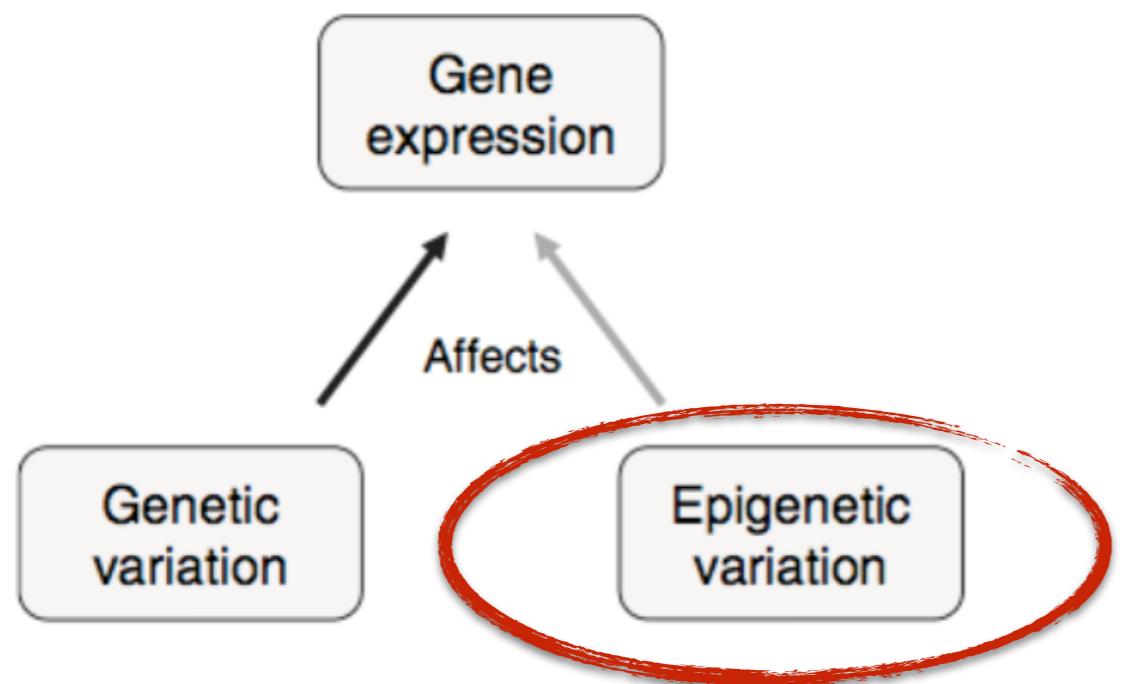
November 2<sup>nd</sup>, 2016



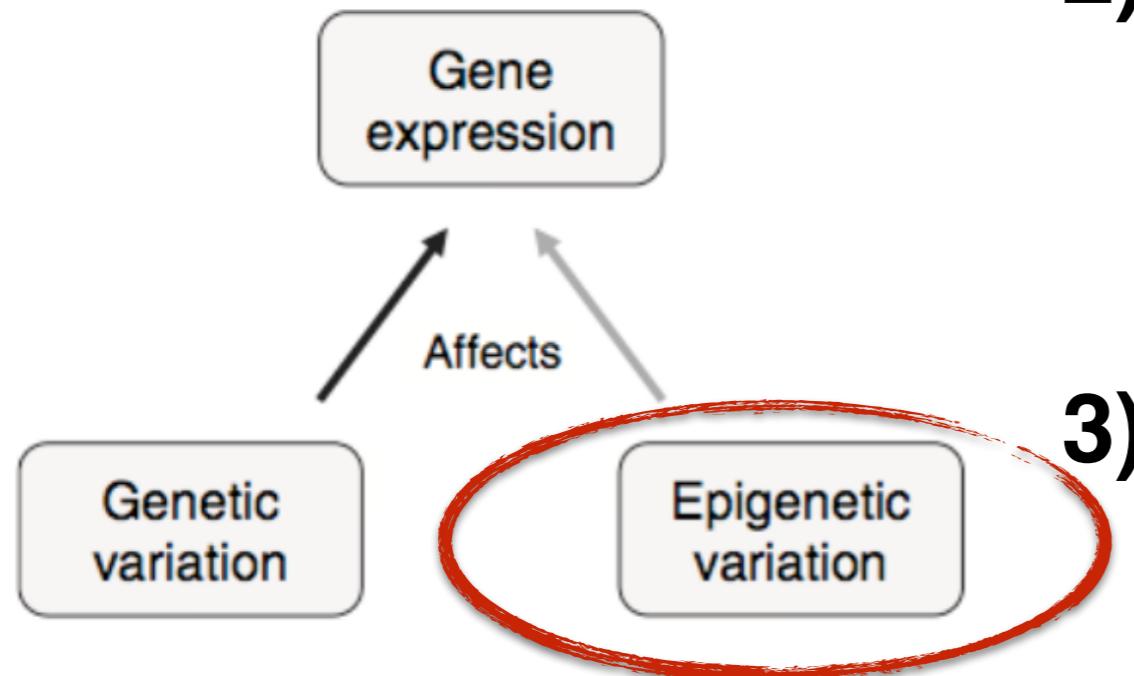
# Background



# Big Questions

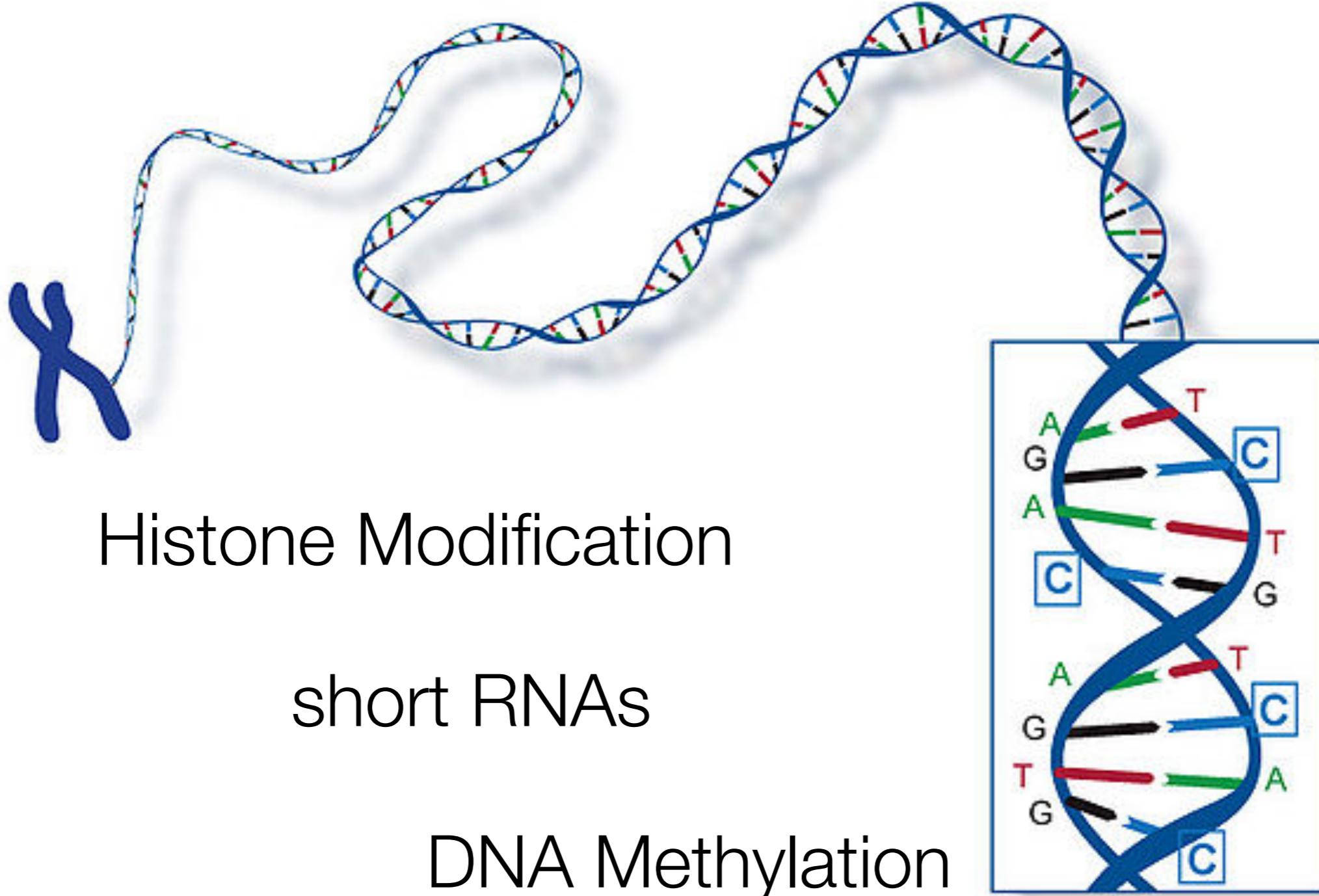


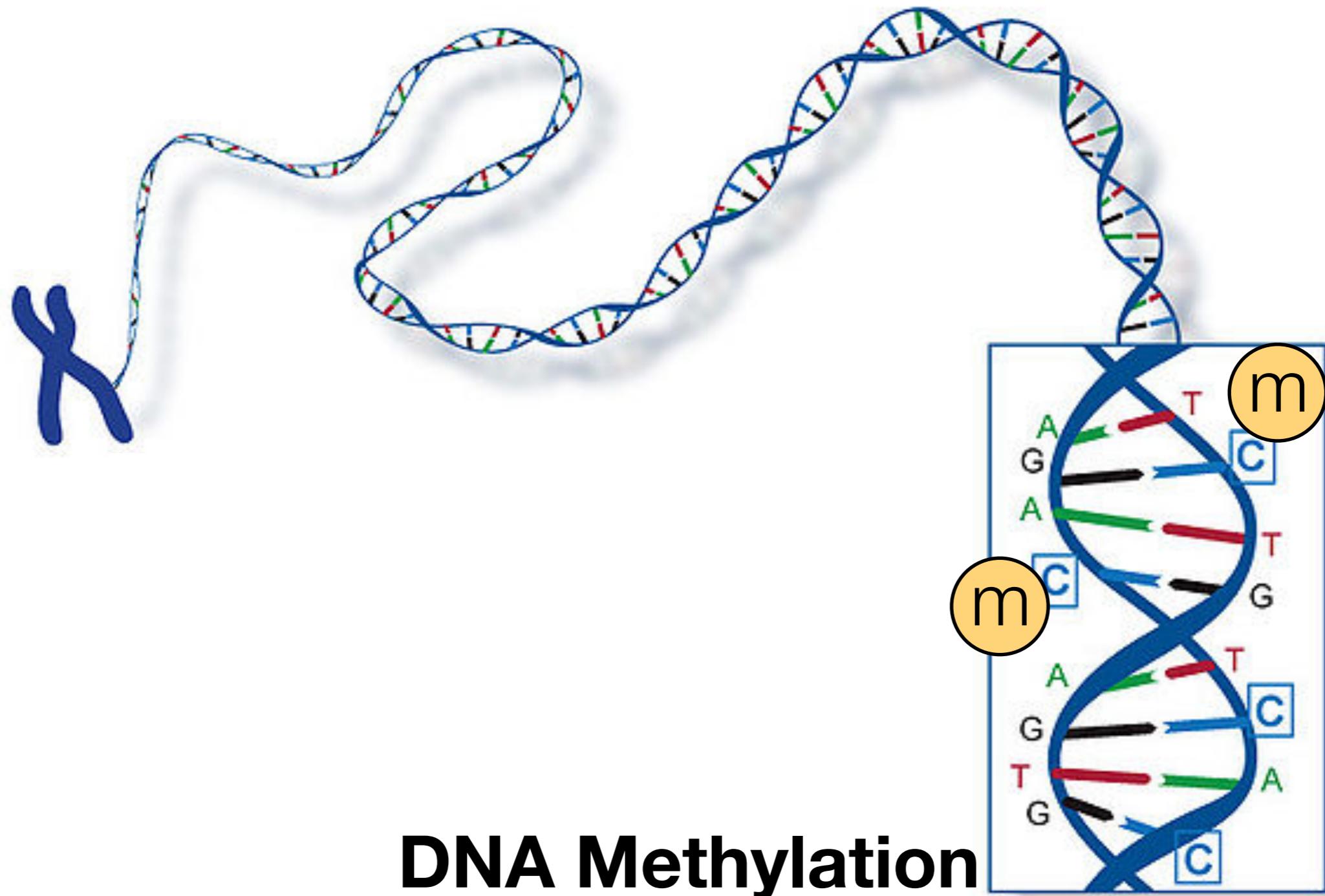
# Big Questions



- 1) To what degree is epigenetic variation heritable?**
- 2) Is epigenetic variation independent of genetic variation?**
- 3) How do environmental conditions influence epigenetic variation?**
- 4) What type of epigenetic phenomenon contributes most to phenotype?**

# Epigenetics





# Outline

**Methylation landscape**

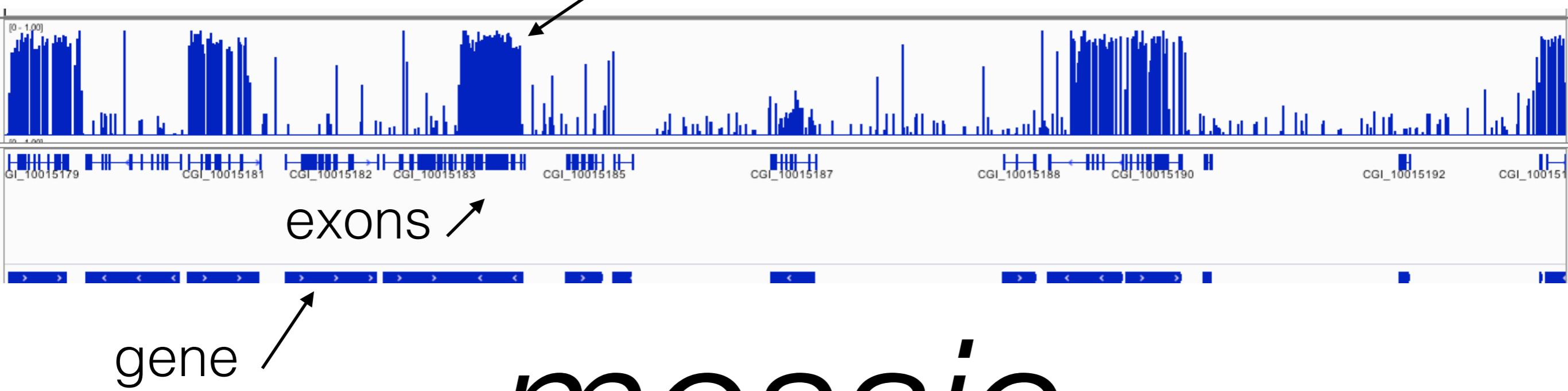
**Population studies**

**Environmental change**

- 1) To what degree is epigenetic variation heritable?
- 2) Is epigenetic variation independent of genetic variation?
- 3) How do environmental conditions influence epigenetic variation?

# Methylation landscape

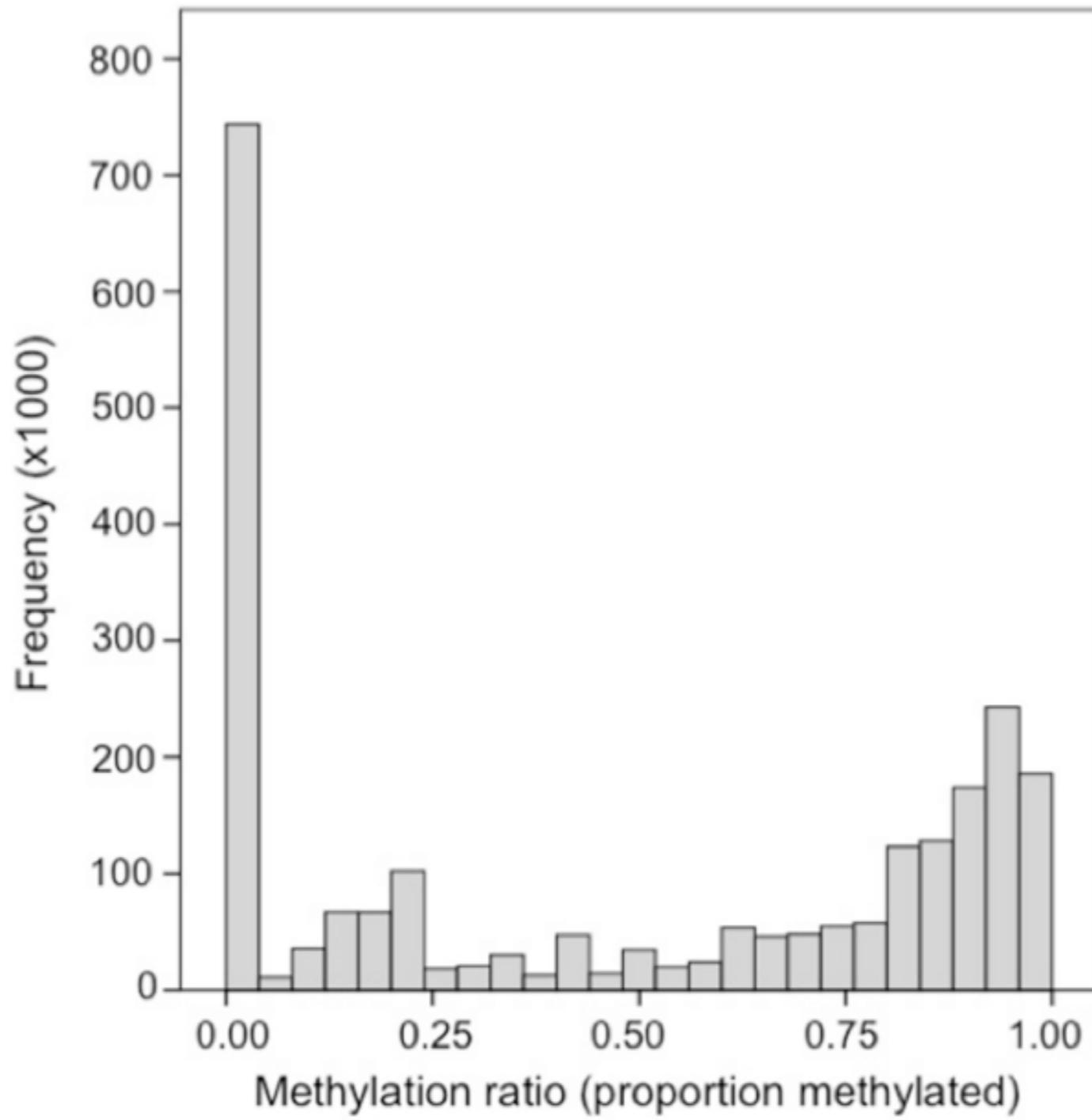
DNA methylation level (0-100%) @ cytosines



*mosaic*

associated with gene bodies

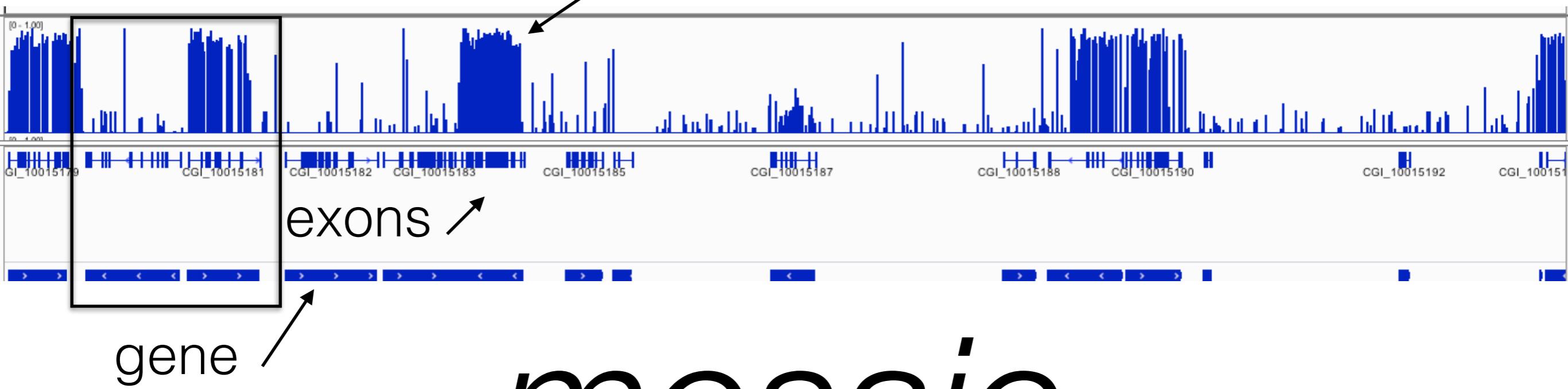
# Methylation landscape



**Figure 1** Frequency distribution of methylation ratios for CpG dinucleotides in oyster gill tissue. A total of 2,625,745 CpG dinucleotides with  $\geq 5 \times$  coverage are represented.

# Methylation landscape

DNA methylation level (0-100%) @ cytosines

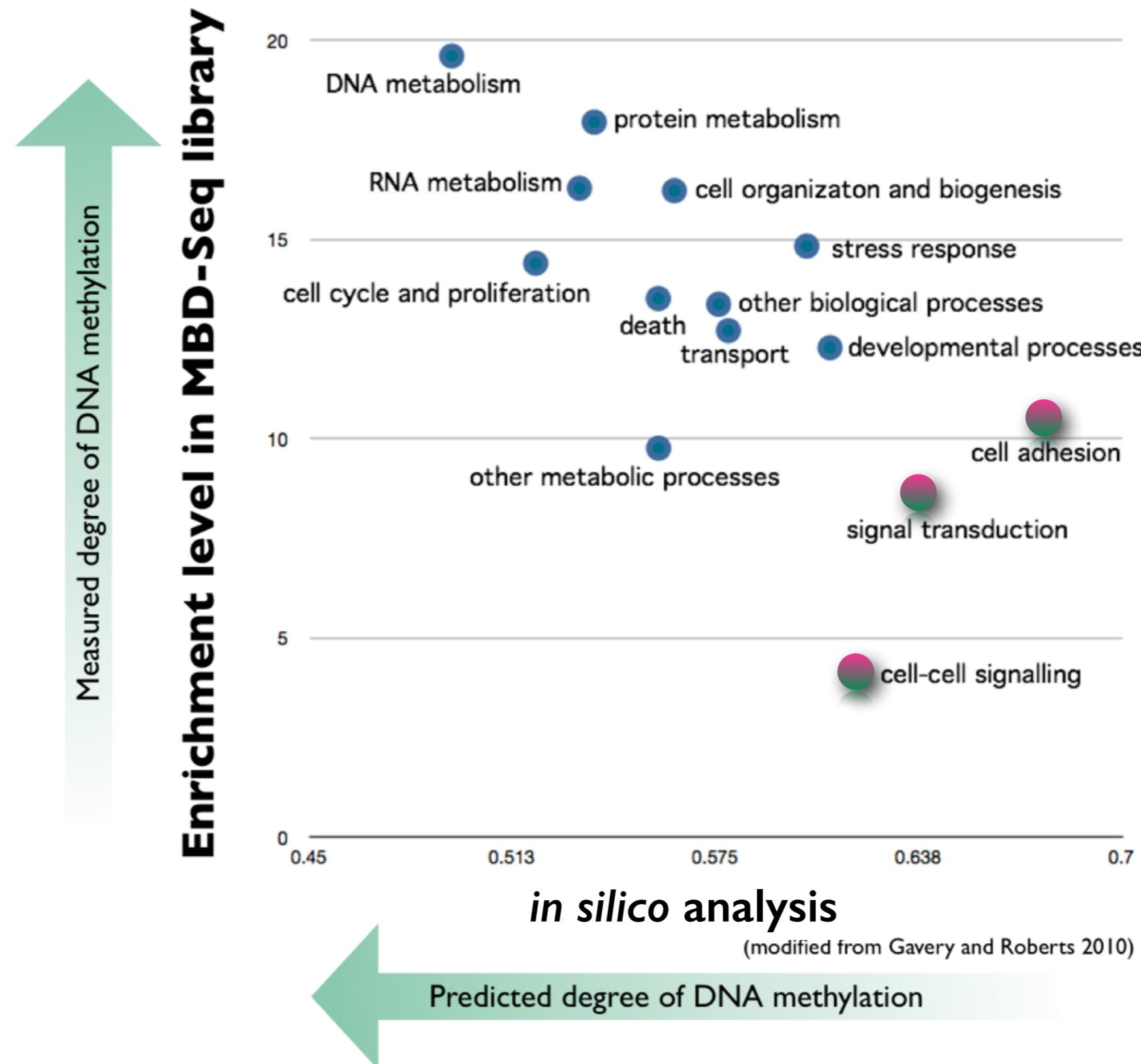


*mosaic*

Why are only a subset of genes methylated?

associated with gene bodies

# Methylation landscape



# Outline

1) To what degree is epigenetic variation heritable?

Methylation landscape

2) Is epigenetic variation independent of genetic variation?

Population studies

3) How do environmental conditions influence epigenetic variation?

Environmental change

# Population studies



## Reciprocal Transplant Experiment



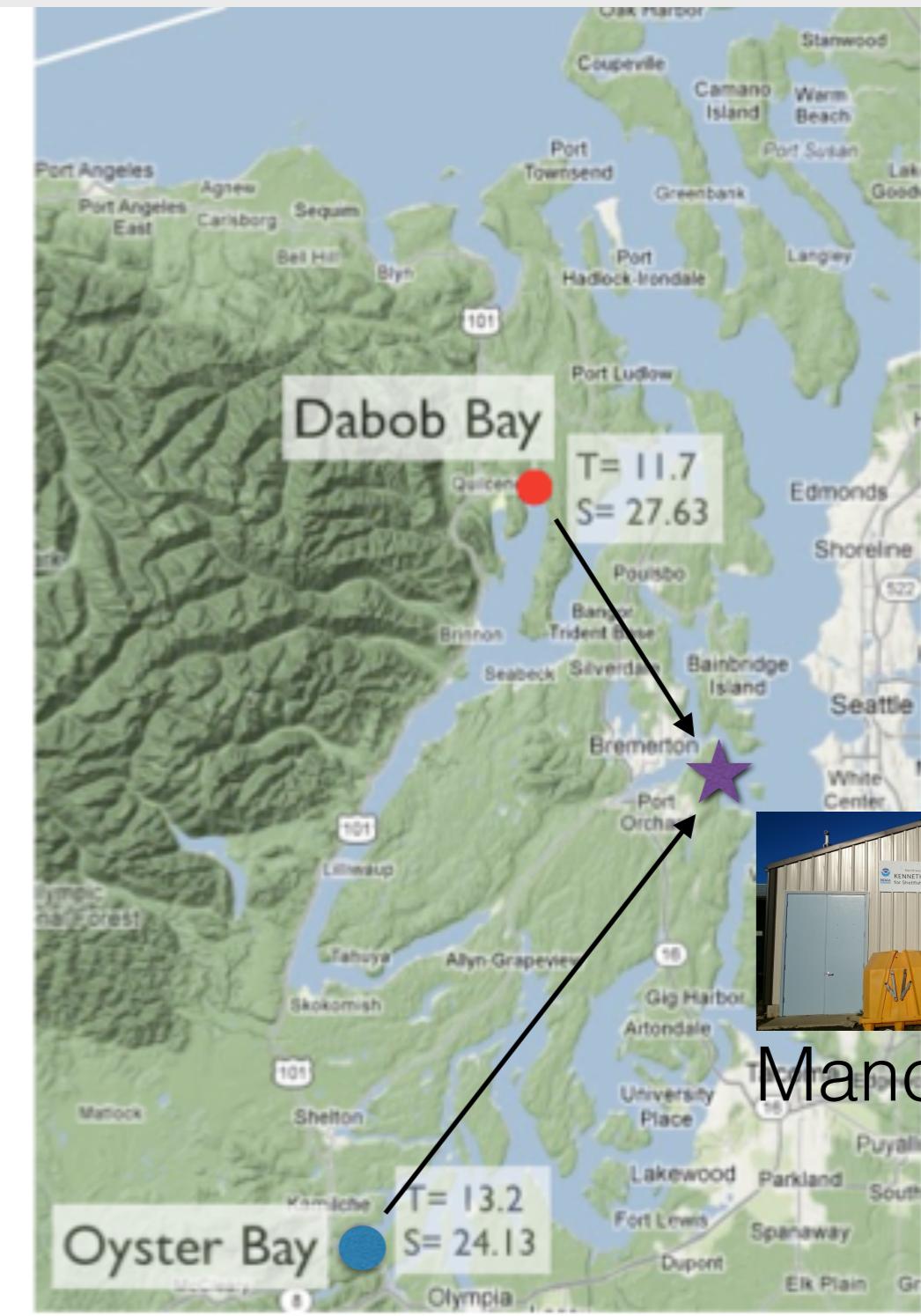
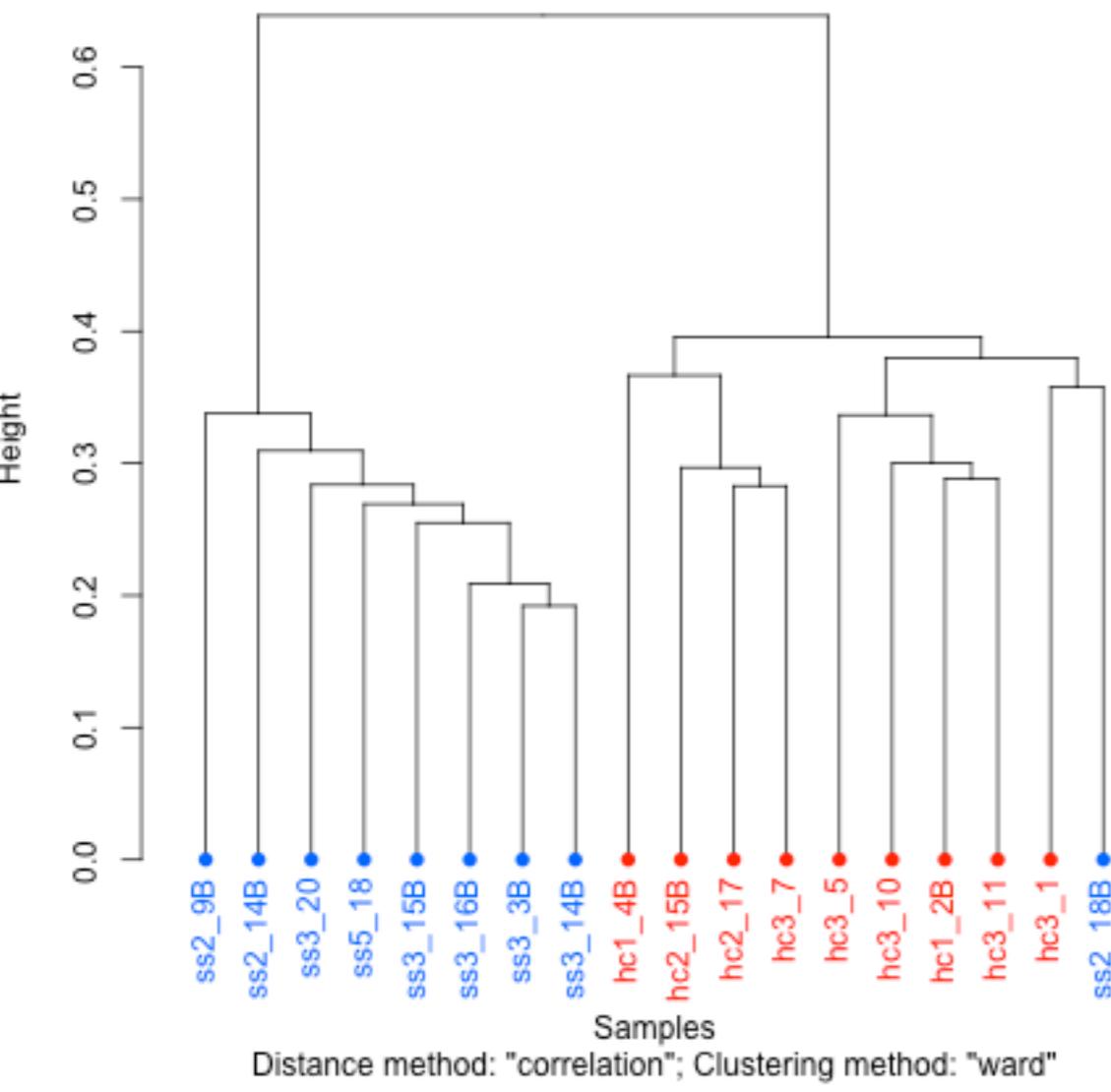
Manchester

# Population studies



## Reciprocal Transplant Experiment

CpG methylation clustering



Manchester

# Population studies



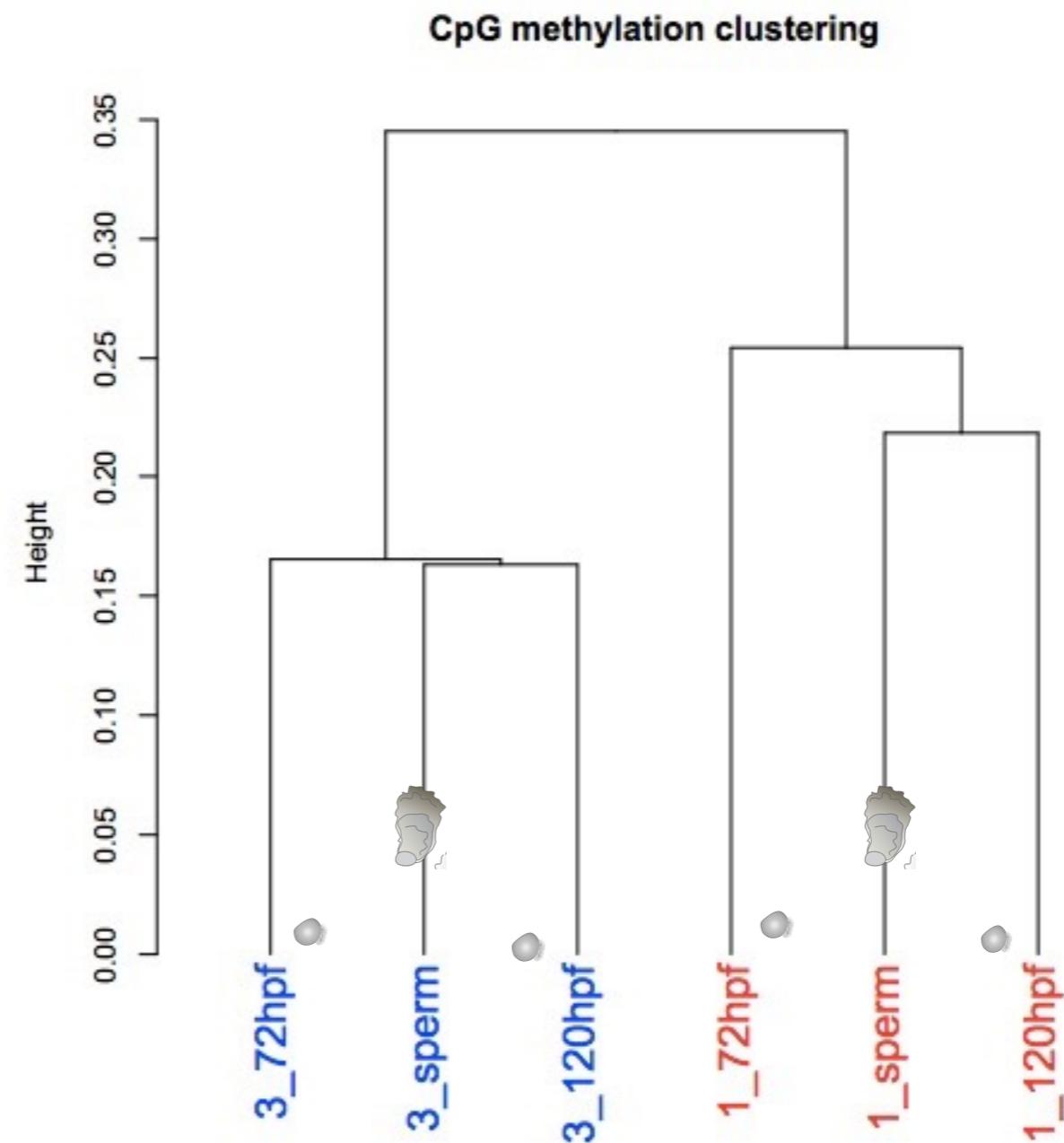
**bioRxiv**  
beta  
THE PREPRINT SERVER FOR BIOLOGY

New Results

**Indication of family-specific DNA methylation patterns in developing oysters**

Claire E. Olson , Steven B. Roberts

doi: <http://dx.doi.org/10.1101/012831>



# Outline

1) To what degree is epigenetic variation heritable?

Methylation landscape

2) Is epigenetic variation independent of genetic variation?

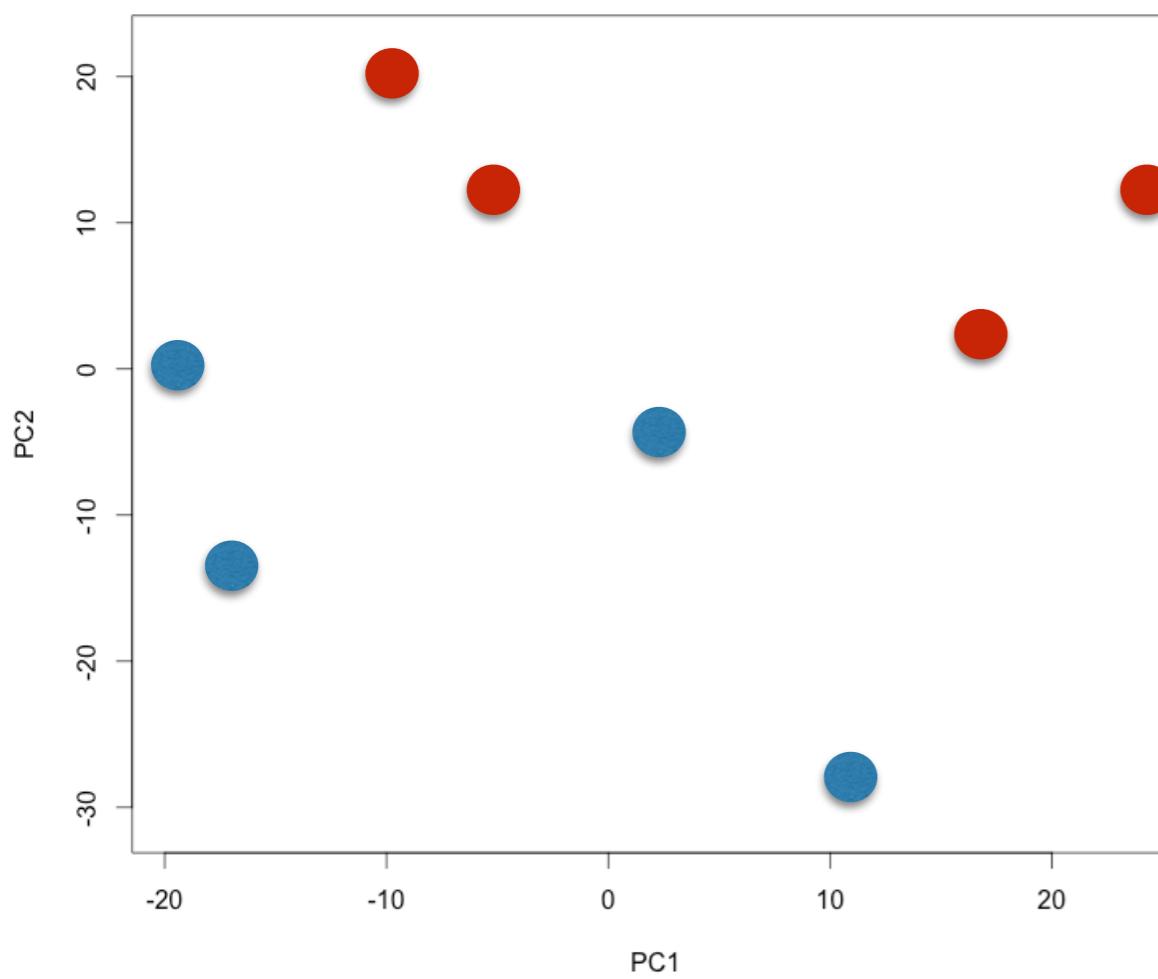
Population studies

3) How do environmental conditions influence epigenetic variation?

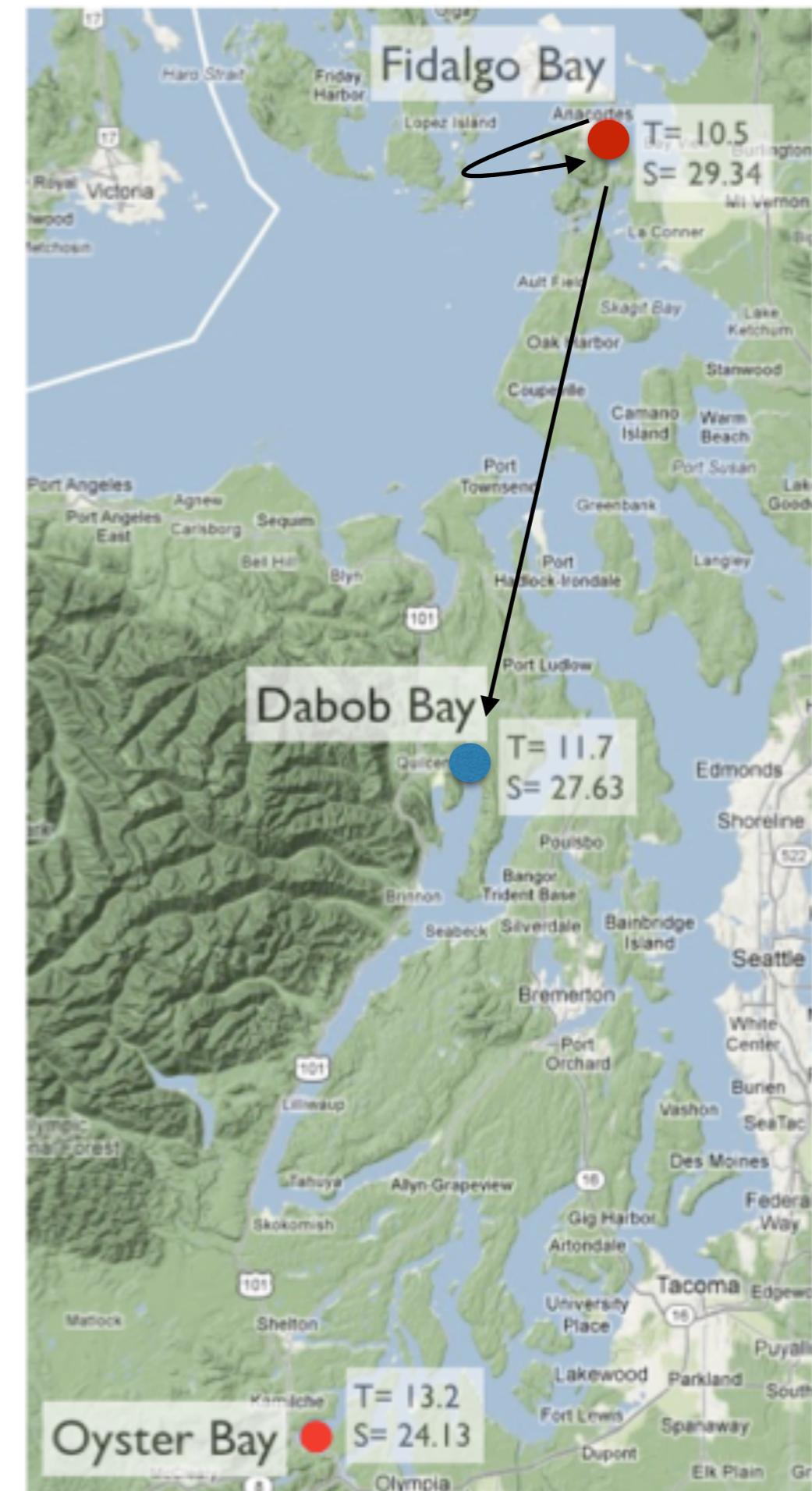
Environmental change

# Environmental change

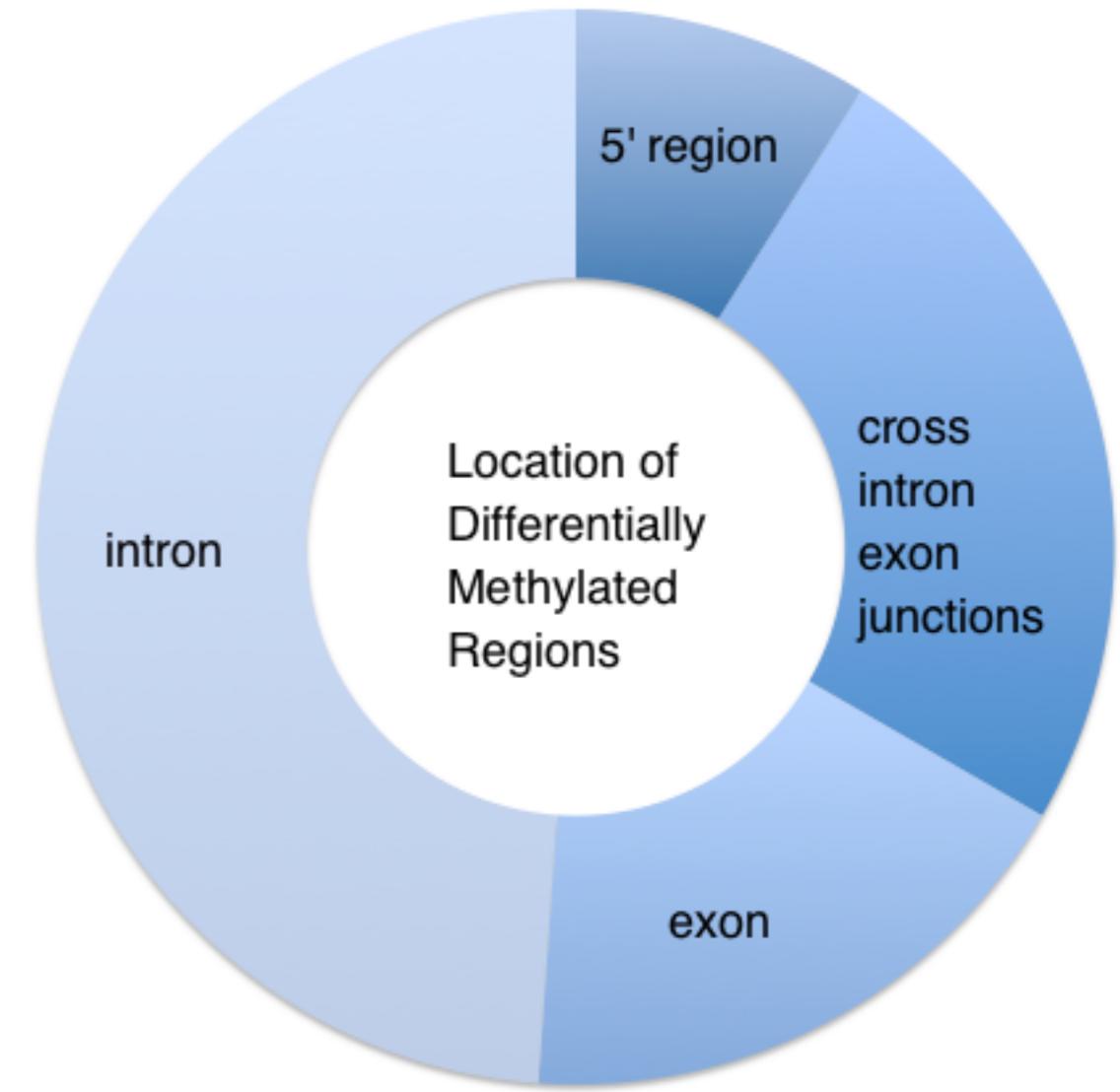
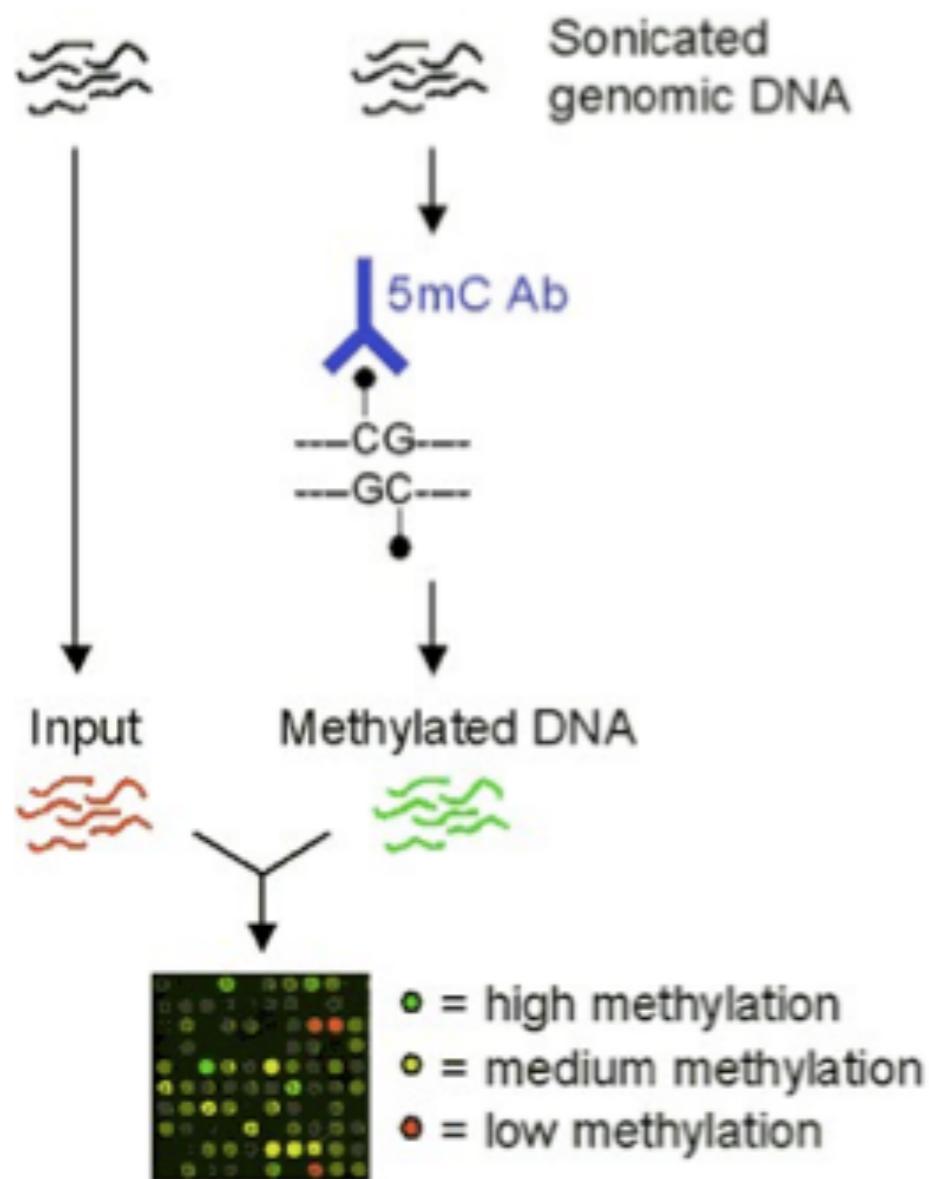
CpG methylation PCA Analysis



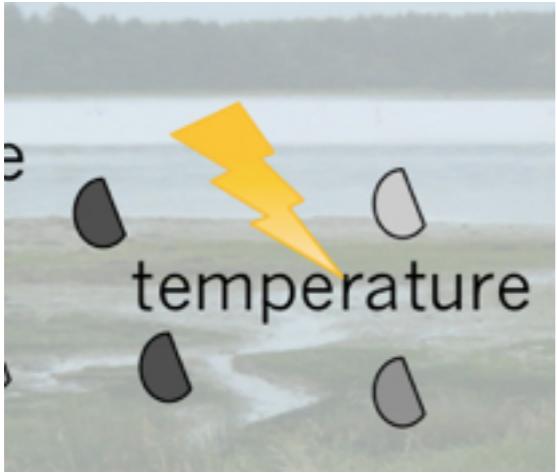
DNA methylation  
siblings grown different sites



# Environmental change



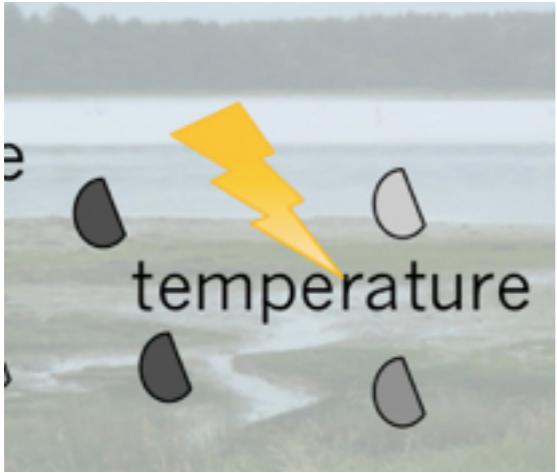
# Environmental change



*stochastic or targeted?*

Oyster	Hypo-methylated	Hyper-methylated
2	7224	2803
4	6560	3587
6	7645	4044

# Environmental change



*stochastic or targeted?*

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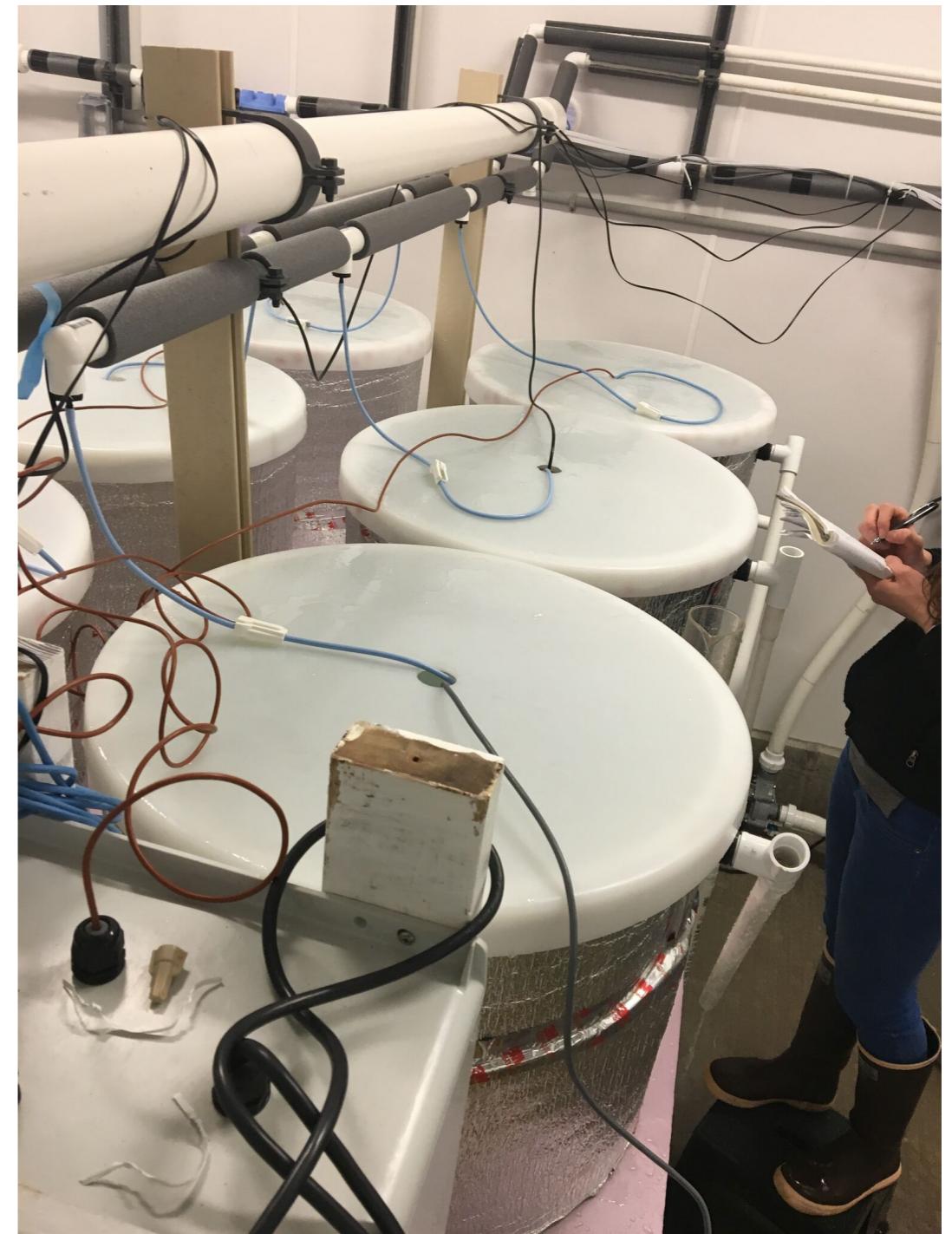
No obvious association  
with genome feature  
including *differentially  
expressed  
genes*

# Environmental change

Very new ~~data~~

Selection

Ocean Acidification



Day 10

Proportion of sequences in pooled  
larvae sample with given allele (G vs A)

Day 1

Control: Random Mortality

~42% ACGCTGATCGT  
~38% ACGCTAATCGT

~42% ACGCTGATCGT  
~38% ACGCTAATCGT

High  $p\text{CO}_2$ : Non-random  
Mortality

~80% ACGCTGATCGT  
~20% ACGCTAATCGT

Day 10

High  $p\text{CO}_2$   
Ambient temperature

High  $p\text{CO}_2$   
High temperature

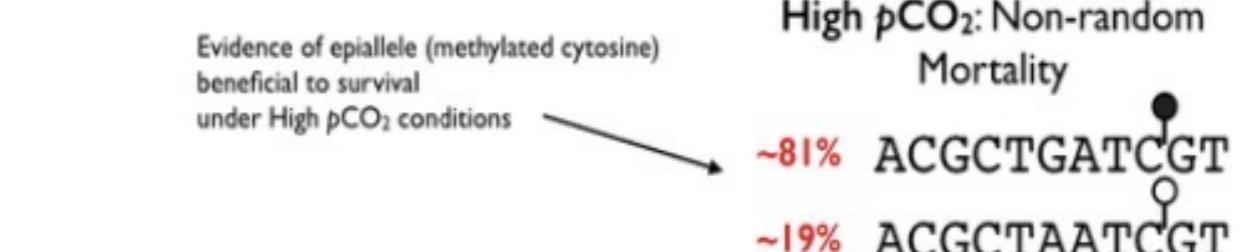
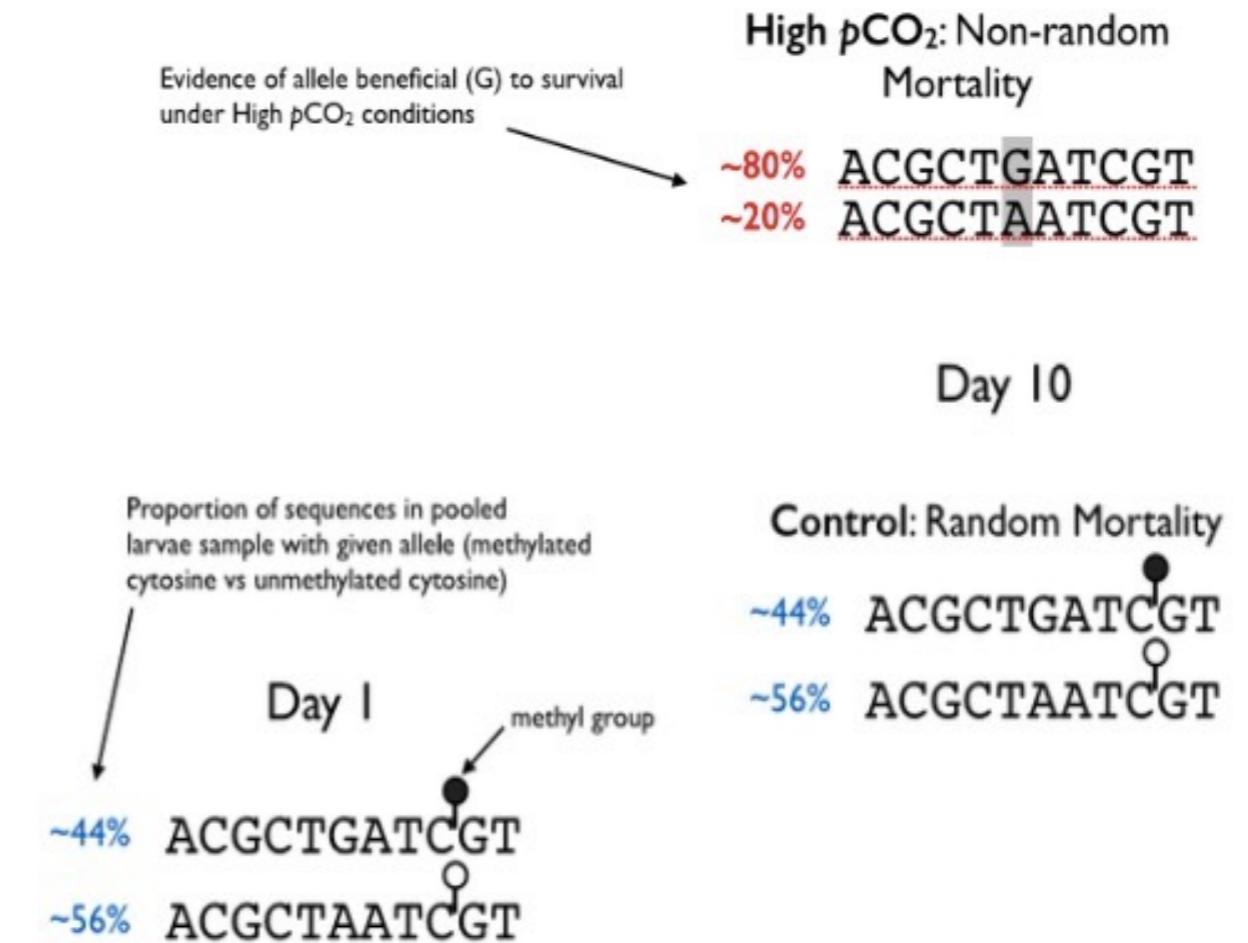
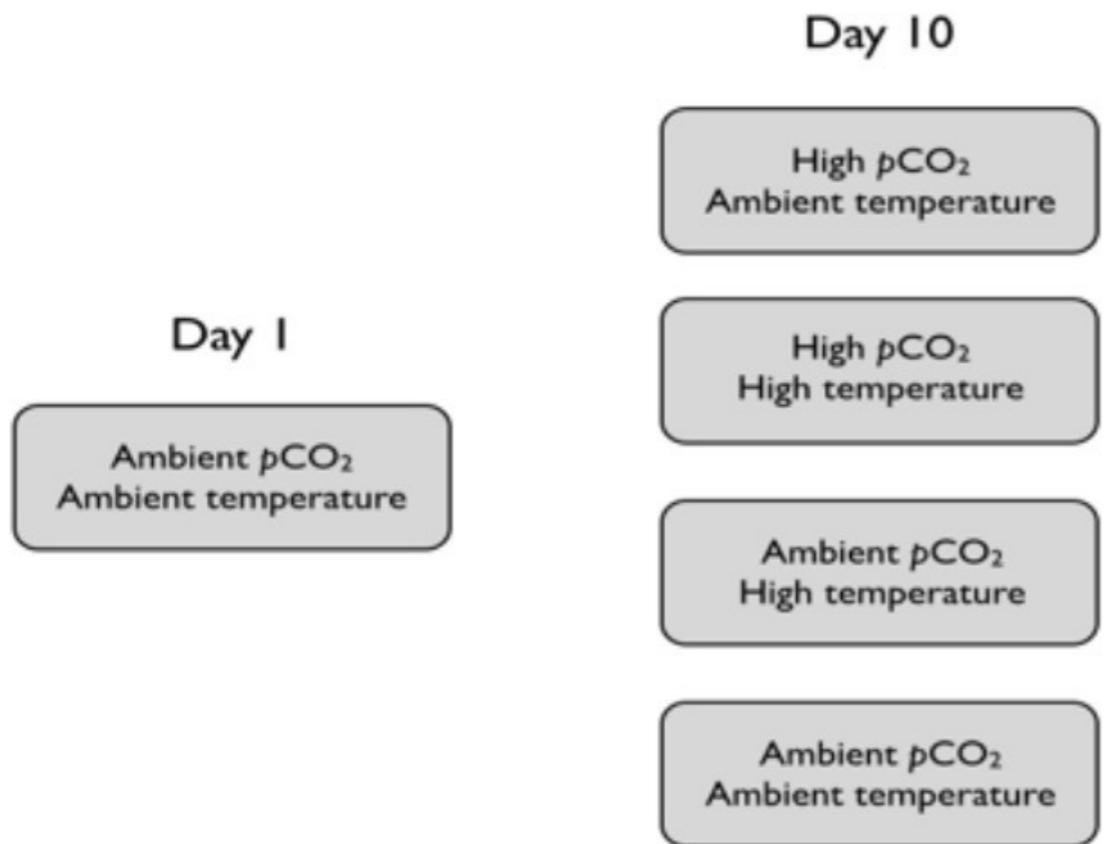
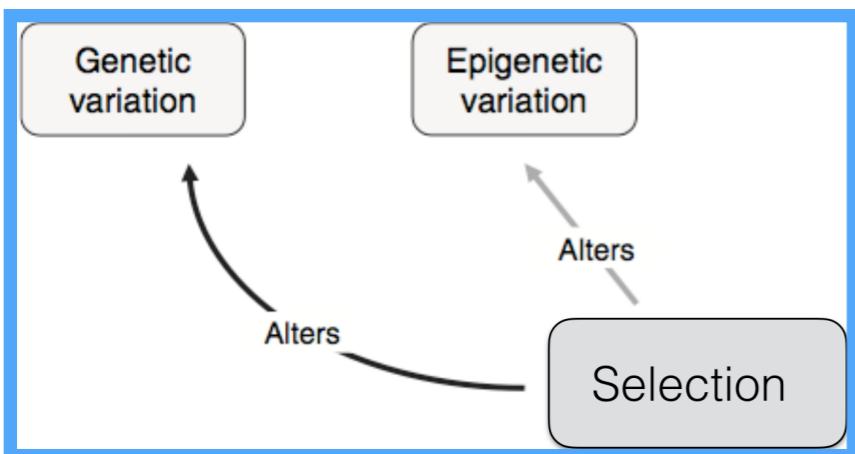
Ambient  $p\text{CO}_2$   
High temperature

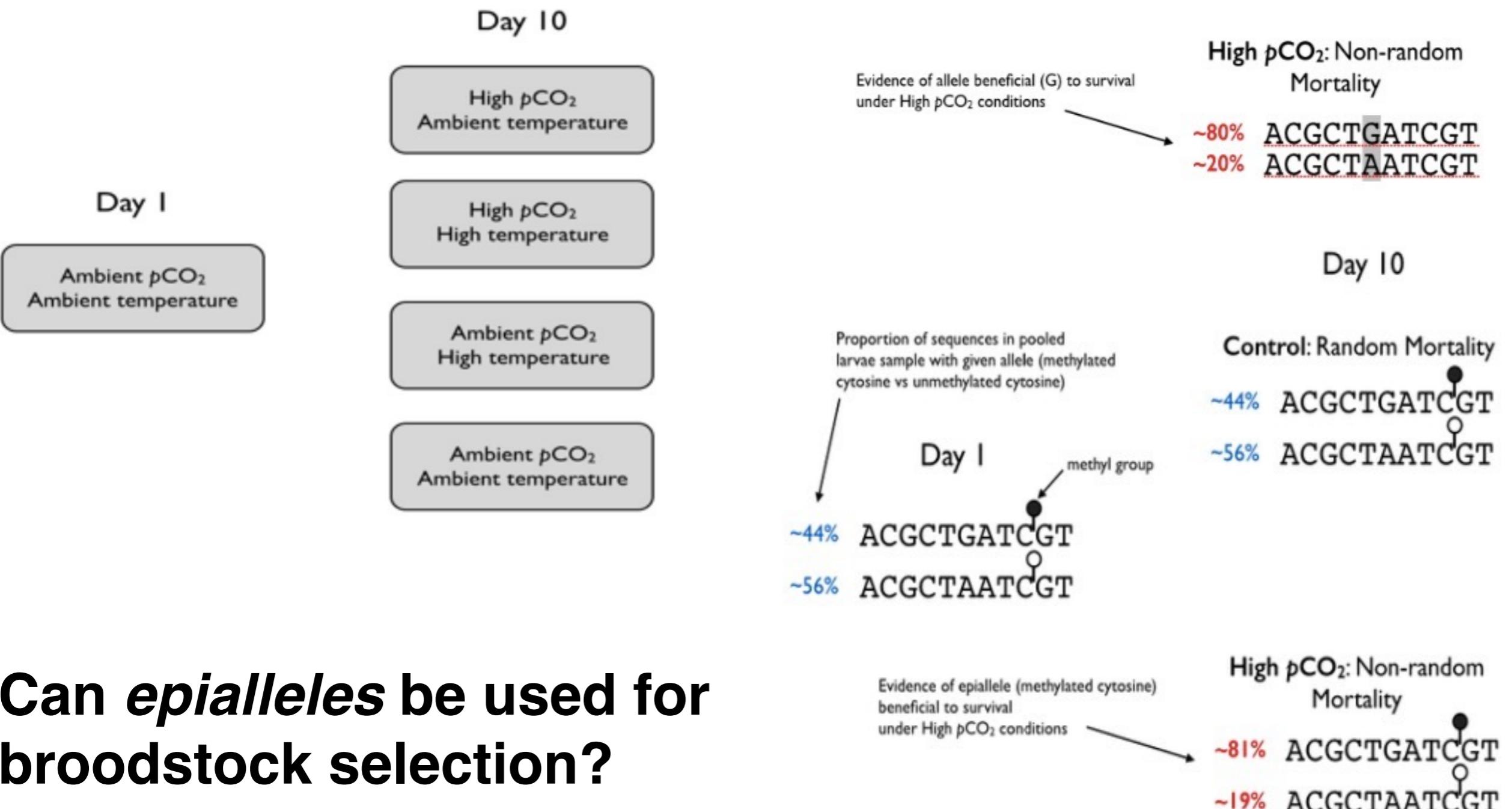
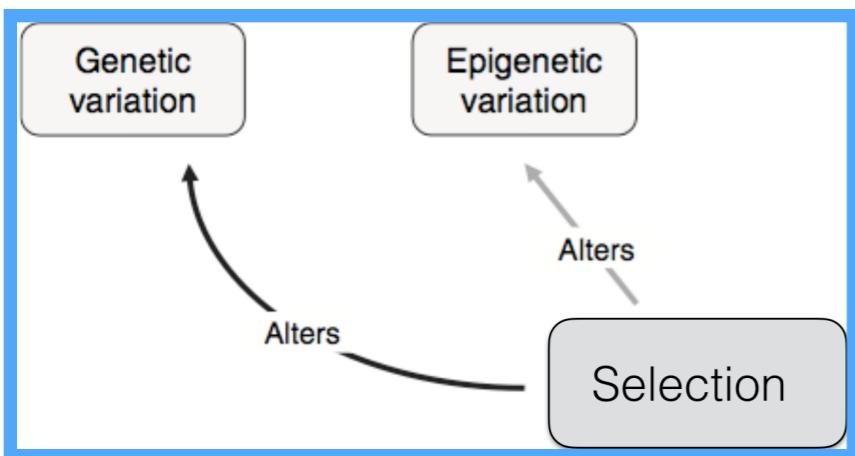
Ambient  $p\text{CO}_2$   
Ambient temperature

Evidence of allele beneficial (G) to survival  
under High  $p\text{CO}_2$  conditions

Day 1

Ambient  $p\text{CO}_2$   
Ambient temperature





# Can *epialleles* be used for broodstock selection?

## Summary

Particularly in *shellfish*, epigenetics should be given considerable attention in understanding and optimizing phenotype.

# Acknowledgements

Mackenzie Gavery

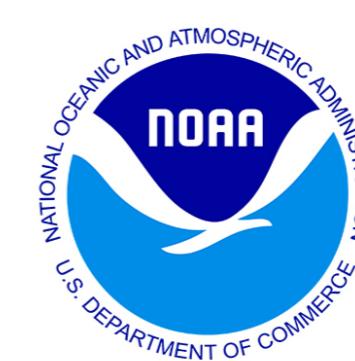
Claire Olson

Sam White

Brent Vadopalas

Hollie Putnam

Laura Spencer



slides, data & more @  
[github.com/sr320/talk-unjr-2016](https://github.com/sr320/talk-unjr-2016)